<English Language Translation>

JAPANESE LAID-OPEN PATENT APPLICATION NO. 2000-293540

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[0007]

[Embodiment of the Invention]

An embodiment of the present invention will be described with figures.

[0008] (1) Principle of action prediction method

The discrete model which consists of four elements is used for the action prediction method of this invention. The four elements that constitute this discrete model composed of ENTITY expressing an entity and a man existing in a system (first), EVENT expressing as an event which caught one cross section of the phenomenon generated, without taking consumption of time amount into consideration (second), ACTIVITY expressing performances and actions performed by ENTITY (third), and PROCESS showing the phenomenon which includes time amount progress by the train of EVENT (or ACTIVITY) related to the ENTITY paying attention to a certain ENTITY (fourth).

[0009] These elements are shown as an example below. As shown in figure 1, a visitor is set as ENTITY, which is the first element with an action of the visitor who purchases a ticket with a ticket-vending machine. The EVENT as the second element available are: Arrival EVENT by which a visitor joins on the queue for a ticket-vending machine; Start of service EVENT by which the visitor will begin to buy a ticket with a ticket-vending machine after queuing; and End of service EVENT by which the visitor finishes buying a ticket with a ticket-vending machine. And ACTIVITY which is the third element will express the action by which a visitor purchases a ticket, and PROCESS which is the fourth element will express the EVENT train related to the visitor.

[0010] Thus, only the event (EVENT) which has important meaning about performance and action of ENTITY (visitor) is used for action prediction of ENTITY (visitor) which is a modeling in discretely by the train (PROCESS).

[0011] Therefore, in this discrete model, a clocking serves as an ununiformity for the time depending on occurrence time by measuring the time amount by the important event (EVENT).

[0012] Here, a fundamental modeling about a certain subject (ENTITY) can be performed by the action (ACTIVITY) of a subject and the processing period (time amount from which ACTIVITY begins to finish) concerning to a certain subject (ENTITY). That is, as shown in figure 2, the train of ACTIVITY which has each processing time, and a subject (ENTITY) constitute a fundamental model.

[0013] In this fundamental model, a subject's action is caught as action of a discrete change, the time changing action, and the next action after the change are expressed as a discrete model of a behavior pattern, and action is predicted using this discrete model.

[0014] Next, how to discrete-modelizing the behavior pattern used for a subject's action prediction is described. In the method of generating this discrete model, the subject being ENTITY is for example a user here, and a position detection means detects the actual action (a location and traveling) of the user, and stay and traveling condition of the user are extracted as Stay ACTIVITY and Move ACTIVITY using the extraction result, which mentioned later.

[0015] That is, as shown in figure 3 , with a position detection means (mentioned later), a user's location is detected for every (not necessary to be every fixed time amount) predetermined time, and the detected positional information and the time are accumulated as EVENT.

[0016] And then ACTIVITY is extracted based on these accumulated EVENT. In this case, EVENT1 and EVENT2 are the same locations among two or more accumulated EVENT(s), and EVENT3 is a different location from EVENT2, and presupposes further that EVENT3 to EVENT6 a mutually

different location. Moreover, to EVENT6, EVENT7 is a different location and presupposes that EVENT7 to EVENT10 are the same location, respectively.

[0017] In such a detection result of each EVENT, it turns out about EVENT1 and EVENT2 that the user is staying at the same location in this time. On the other hand, about EVENT3 to EVENT6, it turns out that the user is moving in this time. Therefore, stay ACTIVITY is expressed for EVENT1 and EVENT2 side as time which replaces ACTIVITY in the middle time T11 of EVENT2 and EVENT3, and Move ACTIVITY is expressed for EVENT 3 to EVENT 6 as user's travel. EVENT7 to EVENT10 expresses that the user stays at the same location in this time. The middle of the time T12 of EVENT6 and EVENT7 expresses as time which ACTIVITY replaces, EVENT 7 to EVENT 10 side expresses user's stay, Stay ACTIVITY. It should be noted that the departure point in Move ACTIVITY for EVENT3 to EVENT6 is the place-of-stay point of Stay ACTIVITY. The destination point of Move ACTIVITY is the place-of-stay point of Stay ACTIVITY following Move ACTIVITY. Thus, Move ACTIVITY is expressed by a departure point, a destination point and a required time (time T11-T12).

[0018] Thus, an EVENT train of the time of user's stay at the same location is summarized as one stay ACTIVITY, and also EVENT train of the time of user's traveling as one Move ACTIVITY.

[0019] The procedure for extracting ACTIVITY from this EVENT is shown in figure 4. That is, in figure 4, if an action prediction system goes into the procedure concerned from step SP 10, the action prediction system judges whether access interval which incorporates EVENT which is a user's location in the continuing step SP 11 is 30 minutes or less. EVENT, by which access interval was incorporated in 30 minutes or more, becomes inadequate in terms of dependability in the relation before and after, for newly generating ACTIVITY. Therefore, in this case, the action prediction system obtains a negative result in step SP 11, and moves to step SP 12.

[0020] In step SP 12, the action prediction system judges whether the correspondent to EVENT incorporated at this time exists, in other words, whether the same position with the EVENT is available, in the Stay ACTIVITY.

In the case where a negative result is obtained here, it expresses that the EVENT incorporated at this time does not exist in the Stay ACTIVITY and access interval is 30 minutes or more. At this time, the process moves to step SP 13, the action prediction system stores the data of EVENT in a temporary data storage area (Tmp Box).

[0021] On the other hand, in the case where a positive result is obtained in step SP 12, access interval of EVENT incorporated at this time is 30 minutes or more, and same EVENT exists in the Stay ACTIVITY. At this time, the process moves to step SP 14, the action prediction system updates Data storage area (ACTIVITY Box) which stored ACTIVITY data as one of the population of the existing ACTIVITY which corresponds to the EVENT.

[0022] Thus, only in the case where existing Stay ACTIVITY consisting of the same population is available, EVENT or the EVENT train whose access time is 30 minutes or more is incorporated into the population.

[0023] Moreover, in the case where a positive result is obtained in the above-mentioned step SP 11, it expresses that access interval of incorporated EVENT at this time is less than 30 minutes. At this time, the process moves to step SP 15, the action prediction system judges whether EVENT or the EVENT train incorporated at this time is Stay ACTIVITY or Move ACTIVITY based on correspondence relation (figure 3) with EVENT of immediately before and after the EVENT.

[0024] Incidentally, as decision in step SP 15, the action prediction system considers that this action is a stay at one certain point (area), when data interval of head and termination of an EVENT train is 20 minutes or more, and is the same location (EVENT). Moreover, when the distance and the time interval between the points going threough are extremely long, the action prediction system does not to consider that this is Move ACTIVITY.

[0025] And in step SP 15, if Stay ACTIVITY is obtained as the judgment, the process moves to step SP 16, the action prediction system judges whether the Stay ACTIVITY consisting of the same population (EVENT) exists. In the case where a positive result is obtained here, it expresses that existing Stay ACTIVITY same as Stay ACTIVITY based on EVENT or the EVENT train

incorporated at this time is available. At this time, the process moves to step SP 16, the action prediction system updates Data storage area (Stay ACTIVITY Box) which stored stay ACTIVITY data as one of the population of the existing ACTIVITY which corresponds to the EVENT or EVENT train judged as Stay ACTIVITY in step SP15 mentioned above. In this way, the EVENT number of the Stay ACTIVITY (the number of parents) increases and the probability of occurrence of the Stay ACTIVITY will increase.

[0026] On the other hand, in the case where a negative result is obtained in step SP 16, it expresses that existing Stay ACTIVITY as Stay ACTIVITY by the EVENT or EVENT train incorporated at this time does not exist. The process moves to step SP 17, at this time, the action prediction system creates a new Stay ACTIVITY using EVENT or the EVENT train judged as Stay ACTIVITY in the above-mentioned step SP 15.

[0027] On the other hand, in the above-mentioned step SP15, in the case where the EVENT train incorporated at this time is judged as Move ACTIVITY, the process moves to step SP 18, the action prediction system judges whether existing Move ACTIVITY which consists of the same population (EVENT train) is available. In the case where a positive result is obtained here, it expresses that an existing Move ACTIVITY same as Move ACTIVITY based on the EVENT train incorporated at this time. At this time, the process moves to step SP20, the action prediction system updates Data storage area which stored Move ACTIVITY data (Move ACTIVITY Box) based on EVENT train judged as Move ACTIVITY in the above-mentioned step SP 15 as one of the population of the existing corresponding ACTIVITY. In this way, the probability of occurrence of the Move ACTIVITY increases in accordance with the position where the Move ACTIVITY goes through, (in other word EVENT).

[0028] On the other hand, in the case where a negative result is obtained in a step SP 18, it expresses that Move ACTIVITY same as Move ACTIVITY based on incorporated EVENT train at this time does not exist. The process moves to step SP19, the action prediction system creates new Move

ACTIVITY using the EVENT train judged as Move ACTIVITY in the above-mentioned step SP 15.

[0029] Incidentally, when the judgment for Stay ACTIVITY or Move ACTIVITY is not obtainable in step SP15, the process moves to step SP 13, the action prediction system stores the data of EVENT at this time in a temporary data storage area (Tmp Box).

[0030] In this way, the action prediction system starts the judgment whether the EVENT is Stay ACTIVITY or Move ACTIVITY in the case where the time of incorporation interval of EVENT becoming not more than 30 minutes, as the procedure shown in figure 4.

[0031] As shown in figure 5, a user's behavior pattern, divided into two kinds of ACTIVITYs (Stay ACTIVITY and Move ACTIVITY), consists of the action pattern model of the first layer formed by Stay ACTIVITY, and the action pattern model of the second layer formed by Move ACTIVITY.

[0032] The action pattern model of the second layer is formed by Move ACTIVITY having the traveling direction toward a destination point from a departure point to the Move ACTIVITY. And. Stay ACTIVITY locates on the corresponding position on the first layer.

[0033] Each Stay ACTIVITY of the first layer and each Move ACTIVITY of the 2nd layer form an object including the various information about user's activities. As shown in figure 6, each Stay ACTIVITY includes ENTITY information representing a respective point, a time starting to stay at the point concerned (T12 in figure 3), a time ending of the stay at the point concerned (T11 in figure 3), a key information (Key) such as a date, a day of the week, a weather at the time of sampling of user's location information, Before ACTIVITY information (a single or plural of ACTIVITY(s) exist) representing ACTIVITY before the Stay ACTIVITY, Next ACTIVITY information (a single or plural of ACTIVITY(s) exist) representing ACTIVITY following Stay ACTIVITY. The number of parents (it represents an EVENT number and the probability of occurrence of ACTIVITY), a user's preference information represented by the service which the user used and the number

of times in the Stay ACTIVITY, and the information related to the point of Stay ACTIVITY (town news etc.), a user name and so on.

[0034] An action prediction system judges whether the ACTIVITY which uses EVENT(s) or an EVENT train as a component exits whenever new EVENT or an EVENT train occurs, as shown in figure 7 according to the procedure mentioned above about figure 4. The matter whether the point of EVENT is the same is used as reference for this judgment. And when the same ACTIVITY exists, the action prediction system adds the EVENT or the EVENT train newly generated as a component of the existing ACTIVITY, and rewrites the number of parents of the ACTIVITY (EVENT number) ( figure 6 ). Moreover, the action prediction system rewrites Before ACTIVITY and Next ACTIVITY considering the relation with ACTIVITY before and after an EVENT and EVENT train generated at this time.

[0035] Moreover, as shown in figure 8, each Move ACTIVITY has ENTITY information which represents a departure point, a destination point, a time required for the Move ACTIVITY (at the time of T11-T12 in figure 3 ), a key information (Key) such as a date, a day of the week, a weather and the like at the time of sampling of user's location information, information on a course point (EVENT) (it is the number of parents for every point, and two or more patterns exist with the probability of occurrence), a user's preference information represented by the service which the user used and the number of times in the Move ACTIVITY concerned, information (town news etc.) about the moving trucking of Move ACTIVITY, a user name and so on.

[0036] Regarding the Move ACTIVITY, the action prediction system judges whether the ACTIVITY which uses these EVENT(s) or an EVENT train as a component whenever new EVENT or an EVENT train occurs like the case of Stay ACTIVITY. A departure point and a destination point are subject to be the same as a reference for the judgment. And when the same ACTIVITY exists, the action prediction system adds EVENT or the EVENT train newly generated as a component (course point) of the existing ACTIVITY, and rewrites the number of parents of the course point of the ACTIVITY (EVENT number) ( figure 8).

[0037] Thus, regarding a Stay ACTIVITY object and a Move ACTIVITY object, information such as the number of parents is updated according to EVENT and the EVENT train which are newly generated. This number of parents is used as the probability of occurrence of ACTIVITY for the action prediction mentioned hereinafter.

[0038] Next, a method for prediction of a user's action using the accumulated Stay ACTIVITY object and Move ACTIVITY object will be explained.

[0039] The accumulated each Stay ACTIVITY object and each Move ACTIVITY object has key information (Key), such as a day of the week at the time of each ACTIVITY occurring, and the weather, (figure 6 and figure 8), and makes an ACTIVITY object, with the key information (Key) corresponding to the day of the week to be predicted and the weather an object to be selected.

[0040] And the action prediction system searches for the ACTIVITY object, which is a prediction candidate, using the information included in each ACTIVITY object such as a time and a departure point to be predicted as search key. For example, when a user specifies the time as from 7:00 in the morning till 5:00 in the evening on Sunday and the weather, the action prediction system searches for an ACTIVITY object with the time and key information (Key) out of the ACTIVITY objects accumulated.

[0041] And the action prediction system creates two or more behavior patterns by linking the two or more ACTIVITY objects based on the point information and the context of the ACTIVITY objects searched out. Regarding the context of the ACTIVITY object, Before ACTIVITY information (figure 6) and Next ACTIVITY information (figure 6) are used for the Stay ACTIVITY object, and the departure point and the destination point (figure 8) are used for the Move ACTIVITY object.

[0042] As shown in figure 9 for example, when a user specifies that the time as from 7:00 in the morning till 5:00 in the evening on Sunday, weather as fine, and the departure point as the user's home, the action prediction system searches for an ACTIVITY object of the specified time as a candidate

out of the Stay ACTIVITY objects and the Move ACTIVITY objects which have the information on the day of the week and weather as key information (Key) (figure 9 (A)), and the Stay ACTIVITY object AO1, which representing for example "staying at home", is set up as initial object out of the group N1 consisting of the candidate objects AO1, AO2,..., AOn searched out(figure 9 (B)), .

[0043] And the action prediction system chooses the Move ACTIVITY object AO2, in which the home is the departure point, as the object of the following ACTIVITY object, and chooses such as Move ACTIVITY object AO3 specified by the Next ACTIVITY information in Stay ACTIVITY object AO1 representing "staying at home".

[0044] Thus, the ACTIVITY object which may follow each selected ACTIVITY object is chosen. In this case, two or more selected ACTIVITY objects may exist, therefore, two or more prediction behavior patterns (PROCESS) which have a linkage for ACTIVITY objects are created.

[0045] Thus, if the ACTIVITY object is included in the predicted time, irrespective of the time of occurrence, the action prediction system is able to obtain the linkage of ACTIVITY objects with a feature of the linkage of the user's behavior pattern as a candidate of action prediction, by creating PROCESS using the information (Before ACTIVITY information and Next ACTIVITY information) showing the context of each ACTIVITY object, and the information (a departure point, destination point) showing linkage.

[0046] As additional matter, the action prediction system in this embodiment defines two regulations as a regulation at the time of forming the train of ACTIVITY objects. As the first regulation, a Move ACTIVITY object always exists between Stay ACTIVITY object and Stay ACTIVITY object. In this way, unusual discontinuity of time can be avoided. As the second regulation, there is a possibility to choose both Stay ACTIVITY object and Move ACTIVITY object before and after Move ACTIVITY object, however, continuous Move ACTIVITY object must locate between the Stay ACTIVITY objects.

[0047] Thus, the action prediction system can create two or more prediction patterns (PROCESS), as shown in figure 9 (B). In addition, each ACTIVITY object has the probability of occurrence according to the EVENT number and number of course points. The occurrence probability is used as a probability at the time of shifting from a certain ACTIVITY object to another ACTIVITY object, consequently the probability of occurrence of each PROCESS can be calculated by a product of the probability of occurrence of each ACTIVITY.

[0048] The prediction result of a behavior pattern including such probability of occurrence is shown in figure 10. In figure 10 , the probability of shifting from ACTIVITYa to ACTIVITYi is 0.6 which is the probability of occurrence of ACTIVITYi, and further the probability of shifting from the ACTIVITYi to ACTIVITYf is 0.55 which is the probability of occurrence of ACTIVITYf. Therefore, the probability of occurrence of PROCESS which consists of, for example, ACTIVITYa-ACTIVITYi-ACTIVITYf-ACTIVITYc-ACTIVITYk is 0.33, which is a product of the probability of occurrence of ACTIVITY.

[0049] Thus, the action prediction system can create two or more PROCESS(s) based on a user's action history out of the ACTIVITY group searched using the time and key information (Key) which were set up.

[0050] (2) Structure of action prediction system

Figure 11 shows the whole configuration of information providing system 10 using the action prediction system. The location of the user who possesses portable terminal device 20 such as PHS is detected by the communication enterprise equipment unit 30 as a terminal unit, and the behavior pattern of the user based on positional information is analyzed in the action pattern analysis server 33 of the communication enterprise equipment unit 30.

[0051] Namely as shown in figure 12 portable terminal device 20 possessed by a user consists of a CPU20A, a memory 20B, a send/receive circuit unit (RF) 20E which sends/receives a signal to/from base stations 21, a baseband processing unit 20D which converts RF signal (Radio Frequency) received by send/receive circuit unit 20E into the baseband signaling, and converts baseband signal to RF signal which is going to be sent, a MMI (Man

Machine Interface) 20F which is the interface of a microphone 20G and a speaker 20H, a display 20I and a keyboard 20J, which are connected each other on a data bus BUS.

[0052] CPU20A performs various actions according to the operation program stored in memory 20B, and controls each circuit unit according to the actions. The various contents of processing of CPU20A are displayed on display 20I consisted of liquid crystal display panels and the like if needed.

[0053] Keyboard 20J supplies the data showing the telephone number to CPU20A, if a user inputs the telephone number of a desired party. CPU20A transmits a connection request through the send/receive circuit unit 20E to the party to call with the telephone number which the user inputted. At this time, a communication line 22 connects a line according to the response from the party to call. If a line is connected, send/receive circuit unit 20E will supply the RF signal received from the party to call through the antenna to baseband processing unit 20D, and convert the RF signal into baseband signal here. Baseband processing unit 20D outputs the sound signal received from the party to call as a voice from speaker 20H by supplying the converted baseband signal to MMI 20F.

[0054] Moreover, if a user inputs voice through microphone 20G, MMI 20F supplies the input sound signal supplied from microphone 20G to baseband processing unit 20D, and converts the baseband signal into a RF signal here. And baseband processing unit 20D transmits the RF signal to the party to call to which the line is connected by sending out the RF signal to a communication line 22 through send/receive circuit unit 20E.

[0055] Moreover, CPU20A transmits the various information inputted when a user operates keyboard 20J through baseband processing unit 20D and send/receive circuit unit 20E, loads the RF signal which has multilayered information received from the party to call, and displays on display 20I.

[0056] In this way, the user using portable terminal device 20 can perform conversation with the party to call, and receive various information.

[0057] CPU20A of portable terminal device 20 sends a location registration signal and identification information (ID information consists of such as

telephone number) of portable terminal device 20 at the predetermined timing to base station 21 in the wireless zone where portable terminal device 20 exists. The base station 21 transmits the location registration signal and ID information which were transmitted from portable terminal device 20 to access server 31 of communication enterprise equipment unit 30. In this way, access server 31 can recognize the location of portable terminal device 20 per wireless zone of the base station, and stores the obtained current location information of the portable terminal device 20 and the time information in, for example, positional information storage unit 35 which consisted of two or more hard disks.

[0058] The current location information stored in positional information storage unit 35 represents EVENT information (figure 3) which sets portable terminal device 20 to ENTITY (figure 1 and figure 2). Therefore, the current location information representing the location and the time is stored whenever a location registration signal is sent from portable terminal device 20, in positional information storage unit 35.

[0059] Here, the action pattern analysis server 33 of the action prediction system which creates an ACTIVITY object has a CPU and a memory connected to the data bus, and CPU performs creation procedure of an ACTIVITY object shown in figure 4 according to the program stored in memory. And the CPU stores the created ACTIVITY object in action pattern information storage unit 34 which consists of two or more hard disks.

[0060] Moreover, CPU of the action pattern analysis server 33 performs an update process of the ACTIVITY object mentioned above for figure 7, whenever the new current location information (namely, EVENT or an EVENT train) of portable terminal device 20 is stored in the positional information storage unit 35, or every predetermined timing. In this update process, when the number of parents of the ACTIVITY object stored in the action pattern information storage unit 34 increases, the value of the probability of occurrence methods to the value which reflects the user's action pattern. As a result, more precise action pattern (ACTIVITY) can be obtained.

[0061] Thus, in the condition that a user's action patterns are accumulated in the action pattern information storage unit 34 as an ACTIVITY object, the action pattern analysis server 33 predicts the action of the user possessing portable terminal device 20, by way of the methods shown in figure 9 and figure 10, using the ACTIVITY objects accumulated in the action pattern information storage unit 34 according to the demand from a service provider 40.

[0062] The server 41 of a service provider 40 has a CPU41A, a memory 41B, a communication link interface 41C, and a database 41D connected to the data bus BUS as shown in figure 13 , and CPU41A performs various processing according to the program stored in memory 41B.

[0063] In other words, CPU41A receives provided information from the various participated terminals (not shown in the figure) through a network connected by communication link interface 41C. Such provided information is such as show guidance to a movie theater, transportation service situation especially useful for the user staying in specific areas and points. Therefore, CPU41A of a server 41 demands information on a user (namely, portable terminal device possessed by the user), who is predicted to visit the specified area and the specified point based on providing time and weather to be provided as information, and information on action pattern (namely, PROCESS) to the action pattern analysis server 33 of communication enterprise equipment unit 30.

[0064] The action pattern analysis server 33, according to the demand, predicts the action of the user, possessing portable terminal device 20, using the ACTIVITY object accumulated in the action pattern information storage unit 34 based on the information of the day of the week and the weather which were specified from the service provider 40 as key information (Key) by the methods mentioned in figure 9 and figure 10.

[0065] In this action prediction processing, action pattern analysis server 33 generates a prediction action pattern (PROCESS) which is a linkage of ACTIVITY objects. In this case, action pattern analysis server 33 generates

two or more prediction action patterns (PROCESS) with different occurrence probability.

[0066] And action pattern analysis server 33 supplies, to server 41 of service provider 40, the action pattern (PROCESS) with the comparatively high probability of occurrence of the user who is predicted to go to a specific area or a specific point under the day of the week and the weather situation specified by the server 41 of service provider 40 in the action prediction result, and also the information which specifies the user, in other words, the ID information which consists of the telephone number and so on of the portable terminal device 20 possessed by the user.

[0067] In this way, CPU41A of server 41 sends the provided information read from the database to portable terminal device 20 based on the action pattern and user Information (information, such as the telephone number which specifies portable terminal device 20) supplied from communication enterprise equipment unit 30, through a network (a network which consists of such as a dish antenna 25 , a satellite 24, and an electric wave tower 23 or a network which consists of a communication line 22 and a base station 21 shown in figure 11) and so on.

[0068] In this case, server 41 reads information which may be especially required with high possibility out of the database before the user's action among the user's prediction action, and transmits, to portable terminal device 20 based on a preference information (service used and frequency) contained in each Stay ACTIVITY object constituting the prediction action pattern (PROCESS) supplied from communication enterprise equipment unit 30 and information about point, and also a preference information (service used and frequency) contained in each Move ACTIVITY objects and information about moving trucking.

[0069] As a method to choose the information which being required by the user with high possibility, server 41 chooses service with more frequencies than the predetermined threshold among user's preference information (service used and frequency) included in each ACTIVITY object supplied from the communication enterprise equipment unit 30, as well as

information especially effective on a user's action prediction path based on the information about a user's moving trucking and point which are included in each ACTIVITY object, and then transmits these information to portable terminal device 20.

[0070] In this way, the user possessing portable terminal device 20 can receive beforehand the information to be needed for every time and location in the user's action according to the preference of the user.

[0071] Information providing system 10 using the action prediction system, uses the encryption which can be decrypted only between both units which perform communication each other. The units are each terminal unit (portable terminal device 20, such as PHS), communication enterprise equipment unit 30, and the action pattern analysis server 33 which communicates mutually. As this cipher system, a secret key cryptography and a public key cryptography (common key cryptography) are used.

[0072] A secret key cryptography is a method sending and receiving encrypted data using the same key between a transmitting side and a receiving side, and the key is not disclosed when the data is encrypted. More particularly, there is DES (Data Encryption Standard) or Triple DES, and, these secret key cryptography performs code decryption processing rapidly.

[0073] Moreover the public key cryptography is a method which enciphers data using two kinds of keys, a private key and a public key, and, specifically, the public key cryptography has the methods of such as RSA, RC2, or RC4. In this public key cryptography method, when components (for example, portable terminal device 20, communication enterprise equipment unit 30, action pattern analysis server 33) increase in number, the management of a key is easier.

[0074] (3) Action and effect of the embodiment

In the configuration above, an action prediction system regards the user's action as the discretization model which omitted the time judged not to have important meaning rather than regarding a user's action as a continuous change model. This important event means that the time when action

changes, and destination changed, and one action unit such as stay and traveling of user are represented as ACTIVITY.

[0075] Thus, by using the discretization model, it is possible to make the computation time shorter comparing with the case where the equation of motion being used as a method for expressing continuous events.

[0076] Specific meaning to a user is attached to the ACTIVITY object which is the discretization model. For example, information by which a user's action is characterized such as information on the service used, frequency and a point mentioned in figure 6 and figure 8 is included in an ACTIVITY object. Thereby, based on such information, useful information can be provided to a user.

[0077] Moreover, a Stay ACTIVITY object which representing a user's stay action as an ACTIVITY object being the discretization model characterizes the linkage between the actions before and after the user's action using Before ACTIVITY information and Next ACTIVITY information. Moreover, a Move ACTIVITY object representing a user's traveling action associates the points, the departure point information and destination point information.

[0078] Thus, an action prediction system predicts the user's action by characterizing the user's action by the linkage of a discretization model (ACTIVITY object) for example the prediction such as the user visiting a specified place is predicted by action pattern (linkage of ACTIVITY objects) in a time with a predetermined range not the exact time amount. Consequently, as a user's action pattern, even if time shifts somewhat, the user takes the same action pattern in the usual action, it is possible to predict that the user visits a specific place.

[0079] Therefore, the user is able to obtain necessary information without demanding the information provision to a service provider 40 by providing the user with the useful information in advance on a user's prediction action pattern based on the prediction concerned.

[0080] According to the above configuration, a user's action can be predicted easily by predicting a user's action pattern with the discretization model (ACTIVITY object) by which a user's action is characterized.

[0081] The useful information relevant to these information can be provided by making the object have information of contents of user's action and means of transportation by expressing the user's action model by the object.

[0082] Moreover, as shown in figure 14, the action pattern analysis server 33 can classify by color and display a user's action prediction location in a specific time on a display unit with the probability of occurrence based on the information on ACTIVITY object (point information, a time information, and the number of parents). Thereby, for example, the user stays at the point shown with P2 at the time t1 with the highest probability, and the user stays at the point shown with P1 with highest probability next to P2, and then the prediction result can be checked easily with the display screen.

[0083] (4) Other embodiment

It should be noted that in the embodiment mentioned above, as in shown in figure 15, it is described about a case that a location specification function (CPU20A, a base station 21 and the access server 31 of portable terminal device 20) is set in portable terminal device 20, action pattern analysis server 33, the positional information storage unit 35 and action pattern information storage unit 34 are set in communication enterprise equipment unit 30, and also service providing function (server 41) are set in a service provider 40. However the present invention is not limited to this particular case, for example as shown in figure 16, positional information storage unit 35' of portable terminal device 20 may be set in addition to positional information storage unit 35 of communication enterprise equipment unit 30. This structure functions effectively when the method obtaining location information with high frequency is realized. For example, in portable terminal device 20, a lot of positional information is accumulated in a certain time interval, and transmits some amount of information accumulated at a predetermined timing. In this method, the frequency transmitting positional information to communication enterprise equipment unit 30 decreases, and the transmitting process can be facilitated, as a result the communication cost can be reduced.

[0084] Moreover, as shown in figure 17 , while communication enterprise equipment unit 30 has location specification function 20' and service providing function (server 41), a service provider 40 may have the action pattern analysis server 33 and the action pattern storage unit 34. In short in either of portable terminal device 20, communication enterprise equipment unit 30 or service provider 40 may have at least on of a location specification function, an action analysis server, a location information storage unit, an action pattern storage unit or a service providing function.

[0085] The pattern of arrangement of each function and each effectiveness are shown in figure 18.

[0086] Moreover in the above embodiment, Stay ACTIVITY and Move ACTIVITY are judged using 30 minutes as a boundary as the detection time at the time of detecting the location of portable terminal device 20. However, the present invention is not limited to the case. The present invention can be applied various time intervals.

[0087] Moreover, in the embodiment mention above, PHS terminal unit as portable terminal device 20 is exemplified, and a case where location specification method specifying location of the PHS terminal unit based on the location registration signal transmitted to a base station from the PHS terminal unit is shown. However the present invention is not limited to this particular case, for example, a portable terminal device having GPS (Global Positioning System) receiving unit which pinpoints a location based on correlation of signal from two or more satellites, and also various location specification method can be applied.

[0088] Moreover, in the embodiment above, it is described above the case where the various information on a user's action area is shown based on the result of action prediction. However this invention is not limited to this particular case. Various information as providing information can be applied in the case where the result of the comparison differs, the difference is notified to the user.

[0089] Moreover, in the embodiment mentioned above, it is described about the case where PHS terminal unit is used as portable terminal device 20.

However, the present invention is not limited to the case. Various terminals such as a cellular phone, a PDA (Personal Digital Assistant), a car-navigation system, a personal computer, a pocket television, a portable radio can be applied.

[0090] Moreover, in embodiment mentioned above, it is described about the case where a service provider connected to a network is used. However the present invention is not limited to the case. Other various information providing method can be applied.